

## REMARKS

Claims 1-19 and 21 are pending in this application. By this Amendment, claim 21 is added. Support for new claim 21 can be found in the original specification including the claims and figures, for example, see paragraph [0034] of the U.S. Patent Application Publication 2005/0175880 A1. Reconsideration in view of the above amendments and following remarks is respectfully requested.

Applicants gratefully acknowledge the Office Action's indication that the restriction requirement between Groups I and II is withdrawn. However, Applicants respectfully submit that all pending claims are in condition for allowance.

**1. 35 U.S.C. §112, 2nd paragraph**

The Office Action rejects claim 15 under 35 U.S.C. §112, second paragraph as being indefinite. Applicants respectfully submit that the above amendments obviate the rejection. Withdrawal of the rejection is respectfully requested.

**2. 35 U.S.C. §103(a)**

**a. *Nakano et al.* in view of *JP '817***

The Office Action rejects claims 1, 4-6, and 9-18 under 35 U.S.C. §103(a) as being unpatentable over *Nakano et al.* (U.S. Patent Publication No. 2002/0061432, hereinafter "*Nakano*") in view of JP 10-069817 (hereinafter "*JP '817*"). The rejection is respectfully traversed.

Claim 1 recites a composite electrolyte membrane comprising a modified silica in which silicon atoms have substituents as represented by formula 1 and formula 2; and a cation exchange group-containing polymer:

## Formula 1



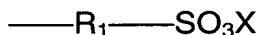
## Formula 2



wherein,  $R_1$  is an alkylene group with 2-7 carbon atoms, X is a hydrogen atom or an alkali metal,  $R_2$  and  $R_3$  are each independently an alkylene group with 2-7 carbon atoms.

Claim 6 recites a fuel cell comprising a cathode; an anode; and an electrolyte membrane being placed between the cathode and the anode, the electrolyte membrane being a composite electrolyte membrane comprising a modified silica in which silicon atoms have substituents as represented by formula 1 and formula 2; and a cation exchange group-containing polymer:

## Formula 1



## Formula 2



wherein,  $R_1$  is an alkylene group with 2-7 carbon atoms, X is a hydrogen atom or an alkali metal,  $R_2$  and  $R_3$  are each independently an alkylene group with 2-7 carbon atoms.

Claim 13 recites a fuel cell which comprises a cathode; an anode; and a composite electrolyte membrane which comprises a cation exchange polymer; and a

modified silica, wherein the modified silica comprises silicon atoms bonded to a propane sulfonates group and a disulfide group.

As stated on page 5 of the Office Action, “Nakano et al does not expressly disclose the silicon-based material having the specific silicon-hydrogen bond; and the specific sulfonate -disulfide groups (as recited in claims 11-16).” See page 5 of the Office Action. Thus, *Nakano* clearly does not disclose or suggest a modified silicon in which silicon atoms have substituents as prepared by formula 1 and formula 2 as recited in claims 1 and 6, as well as the modified silica comprising silicon atoms bonded to a propane sulfonate group and a disulfide group, as recited in claim 13.

*JP '817* fails to cure the deficiencies of *Nakano*. As discussed in the abstract of *JP '817*, “a proton conductor is formed with compound [sic] containing silicon oxide and Bronsted acid and copolymer having sulfonic acid side chains.” See Abstract of *JP '817*. Thus, *JP '817* fails to disclose or suggest both a sulfonate (sulfonic acid) of formula 1 and a group as represented by formula 2. Rather, *JP '817* does not appear to disclose or suggest any silicon atoms having substituents represented by formula 1 and formula 2, as recited in claims 1 and 6. Furthermore, *JP '817* also fails to disclose or suggest a modified silica comprising silicon atoms bonded to a propane sulfonate group and a disulfide group, as recited in claim 13.

The Office Action states that “with respect to the specific sulfonate-disulfide groups (as recited in claims 11-16), when chemical compounds have very close structural similarities and similar utilities a prima-facie case may be made.” See page 6 of the Office Action. However, Applicants respectfully submit that as recited

in the application as originally filed, evidence of useful properties are disclosed that make the claimed invention nonobvious.

As recited in the originally filed specification (emphasis added):

[0034] The disulfide group acts to prevent the swelling of the electrolyte membrane and the sulfonate group acts to improve ionic conductivity of the electrolyte membrane. In the composite electrolyte membrane of the present invention, because the modified silica mechanically fills pore volumes within polymer matrix and the disulfide bond prevents the swelling of the electrolyte membrane, permeation of polar organic fuel such as methanol into the electrolyte membrane is prevented. Therefore, the composite electrolyte membrane of the present invention can substantially reduce the crossover of a polar organic fuel, such as methanol.

This is further emphasized in the following paragraphs [0035] to [0042]. A declaration of the inventors as to their belief in this statement was filed with the application.

Thus, because the specification states that "[t]he disulfide group acts to prevent the swelling of the electrolyte membrane and the sulfonate group acts to improve ionic conductivity of the electrolyte membrane" Applicants respectfully submit that the claims 1, 6, and 13 are not obvious for at least the reasons set forth above.

Applicants note that the MPEP sections and the case law cites noted in the Office Action are dedicated to obviousness of species when the prior art teaches a genus. The Office Action appears to be stating that the "genus" is the sulfonic acid side chains of the *JP '817* reference; however, this "genus" of sulfonic acids would not include disulfides or formula 2 within the "genus." Thus, MPEP 2144.08 would not apply.

The Office Action further states that:

(Emphasis added→) This prima case of obviousness between the claimed species (as recited in claim 13) and the disclosed genus (as recited in claims 1 and 6) is further supported by applicant's statement that all claims of invention of Group I and Group II should be examined together ("*both Groups were examined in the previous Office Action dated 02/23/06*") and applicant's request for withdrawal of the restriction requirement). The examiner has decided to rejoin Groups I and II because even though they are related as combination and subcombination it appears they all encompass a high degree of structural and functional similarity for patentability purposes, thereby forcing the combination (Group II) as claimed to require the particulars of the subcombination as claimed for patentability.

See page 8 of the Office Action.

However, Applicants respectfully submit that both Group I and Group II each include a modified silica in which silicon atoms have substituents as represented by formula 1 and formula 2. See for example claims 1 and 6. While the two Groups are separately patentable, as initially suggested by the Examiner, it was argued that they could be examined together without substantial burden on the office. In both Groups the sulfonate group of formula 1 and the disulfide group of formula 2 are required and are not disclosed or suggested by either *Nakano* or *JP '817*.

The Office Action further states that:

*Moreover, in this case, it is prima facie obvious to combine two compositions each of which is taught by the prior art to be useful for the same purpose, in order to form a third composition to be used for the very same purpose. The idea of combining them flows logically from their having being individually taught in the prior art. A mixture of two compositions knows to individually promote, enhance or improve respective performance characteristics of a feature (i.e. the electrolyte for a fuel cell); or used in the claimed invention and being conventionally employed in the art for treating or enhancing characteristics has been held to be prima facie obvious or unpatentable. See In re Kerkhoven 626 F.2d 846, 850 [sic] 205 USPQ 1069, 1072; In re Crockett 279 F.2d 274, 126 USPQ 186; Ex parte Quadranti 25 USPQ2d 1071; In re Geiger 815 F.2d 686, 2 USPQ2d 1276. (See MPEP 2144.06 Art Recognized Equivalence for the Same Purpose).*

See page 9 of the Office Action (emphasis in the original).

However, neither *Nakano* nor *JP '817* disclose or suggest the combination of features of claims 1, 6 and 13, specifically, neither reference discloses or suggests a silica in which silicon atoms have substituents as represented by formula 1 and formula 2. Rather, each reference does not disclose or suggest a silica having substituents of formula 2, and therefore the "composition" that includes silicon atoms with substituents from formula 1 and formula 2 is not available for a "mixture." Thus, MPEP §2144.06 is also not applicable in this matter. Collectively, the applied art does not teach formula 2 (or disulfide), let alone the combination of formula 1 and formula 2 (or sulfonate and disulfide).

For at least the reasons set forth above, Applicants respectfully submit that claims 1, 6 and 13 are allowable. Claims 4, 5 and 11 depend from claim 1, claims 9, 10 and 12 depend from claim 6, and claims 14-18 depend from claim 13, and are allowable for at least the same reasons. Withdrawal of the rejection is respectfully requested.

b. *Nakano* in view of *Panster et al.*

The Office Action rejects claims 1, 4-6 and 9-18 under 35 U.S.C. §103(a) as being unpatentable over *Nakano* in view of *Panster et al* (U.S. Patent No. 5,380,791, hereinafter referred to as "*Panster*"). The rejection is respectfully traversed.

Applicants respectfully submit that for the reasons set forth above, *Nakano* fails to disclose or suggest all the features of the claims.

*Panster* fails to cure the deficiencies of *Nakano*. Similar to *JP '817*, *Panster* also discloses a sulfonic acid (SO<sub>3</sub>H). While *Panster* discloses both a disulfane and a sulfonic acid, as clearly stated in *Panster*, the polymeric disulfane is utilized in

forming the sulfonated organosilicon compounds disclosed in the patent. Thus, the final product is a sulfonated organosilicon compound that does not include disulfanes, but rather includes sulfonates. See *Panster* column 3, line 1 to column 4, line 2.

Specifically, as illustrated by equation (1), the disulfane group ( $S_2$ ) is converted into a sulfonate group ( $SO_3H$ ). See also columns 5, 6 and 7. Thus, *Panster*, similar to *JP '817*, fails to disclose or suggest a modified silica in which silicon atoms have substituents as represented by formula 1 and formula 2, as recited in claims 1 and 6, and a modified silica comprising silicon atoms bonded to a propane sulfonates group and a disulfide group, as recited in claim 13. Collectively, the applied art does not teach formula 2 (or disulfide), let alone the combination of formula 1 and formula 2 (or sulfonate and disulfide).

As discussed above, because *Panster* fails to disclose or suggest formula 2 of claims 1 and 6, and the disulfide group of claim 13, both MPEP §§2144.08 and 2144.06 are not applicable. Furthermore, as also discussed above, claims 1, 6, and 13 are not obvious because the application as originally filed, specifically, paragraphs [0034] to [0038] disclose the specific non-obvious attributes provided by the claimed inventions of claims 1, 6, and 13.

For at least the reasons set forth above, Applicants respectfully submit that claims 1, 6 and 13 are allowable. Claims 4, 5 and 11 depend from claim 1, claims 9, 10 and 12 depend from claim 6, and claims 14-18 depend from claim 13, and are allowable for at least the same reasons. Withdrawal of the rejection is respectfully requested.

- c. *Nakano* in view of *JP '817*, and/or *Panster*, and further in view of *Deng et al.*

The Office Action rejects claims 2-3, 7-8 and 19 under 35 U.S.C. §103(a) as being unpatentable over *Nakano* in view of *JP '817* and/or *Panster*, and further in view of *Deng et al.*'s publication "*Novel Nafion/Ormosil Hybrids via in-situ Sol-Gel Reactions: 2. Probe of Ormosil Phase Nanostructure by Solid State NMR Spectroscopy*" (hereinafter referred to as "*Deng*"). The rejection is respectfully traversed.

The Office Action states on page 15 that "*Nakano et al.*-the *JP'817* and/or *Nakano et al.*-*Panster et al.* are applied, argued and incorporated herein for the reasons discussed above." However, for at least the reasons mentioned above, Applicants respectfully submit that *Nakano*, *JP '817* and *Panster* fail to disclose or suggest all the features of claims 1, 6 and 13, as well as the claims dependent therefrom. *Deng* fails to cure the deficiencies of *Nakano*, *JP '817* and *Panster*. Rather, the Office Action further states that "*Deng et al.* disclose a NAFION-organically modified silicon (ABSTRACT) wherein all membranes are converted to the SO<sub>3</sub>H form (P. 179, Left Column, 3<sup>rd</sup> full paragraph)." See page 16 of the Office Action.

Additionally, Applicants respectfully submit that *Deng* also fails to disclose or suggest the combination of features of claims 1, 6 and 15; specifically, as to claims 1 and 6, a modified silica in which silicon atoms have substituents as represented by formula 1 and formula 2, and as claimed in claim 13, a modified silica comprising silicon atoms bonded to a propane sulfonates group and a disulfide group. Rather, similar to *Nakano*, *JP '817* and *Panster*, *Deng* also fails to disclose or suggest a silica including formula 2, as recited in claims 1 and 6, or a disulfide group, as recited

in claim 13. Collectively, the applied art does not teach formula 2 (or disulfide), let alone the combination of formula 1 and formula 2 (or sulfonate and disulfide).

For at least the reasons set forth above, Applicants respectfully submit that claims 2 and 3 are allowable for at least the same reasons as claim 1, claims 7 and 8 are allowable for at least the same reasons as claim 6, and claim 19 is allowable for at least the same reasons as claim 13. Withdrawal of the rejection is respectfully requested.

#### **4. New Claims**

New claim 21 is added to the application. Applicants respectfully submit that claim 21, which depends from claim 1, is allowable for at least the same reasons that claim 1 is allowable.

#### **5. Conclusion**

Applicants invite the Examiner to contact Applicants' representative at the telephone number listed below if any issues remain in this matter, or if a discussion regarding any portion of the application is desired by the Examiner.

In the event that this paper is not timely filed within the currently set shortened statutory period, Applicants respectfully petition for an appropriate extension of time. The fees for such extension of time may be charged to our Deposit Account No. 02-4800.

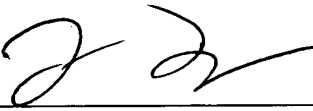
In the event that any additional fees are due with this paper, please charge  
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Respectfully submitted,

BUCHANAN INGERSOLL & ROONEY PC

Date: November 9, 2006

By: \_\_\_\_\_



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